Nadya Submission for Turnitin

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How Important is Environmentally Sustainable-Tourism? Evidence in Indonesia from 1974 – 2018 Using NARDL Cointegration

Abstract

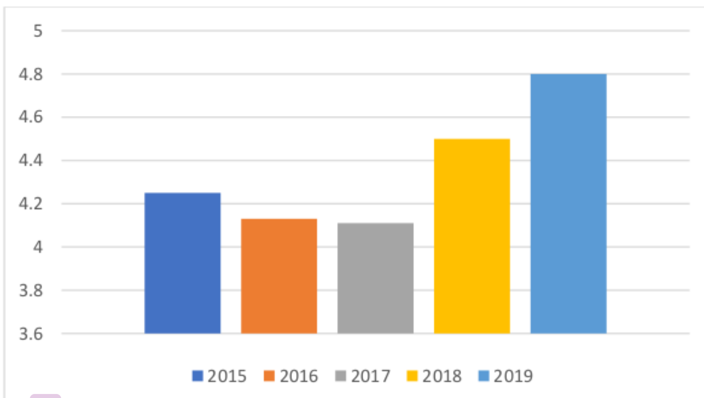
The tourism sector is one of the most important sectors for the Indonesian economy, because it is a mainstay in obtaining foreign exchange which is expected to increase economic growth. However, along with its positive effect on economic growth, the development of the tourism sector is also one of the contributors in increasing CO2 emissions and energy consumption significantly. This study focuses on assessing the impact of the tourism sector as proxied by the number of international tourist visits on GDP per capita and the environment as seen from CO2 emissions and total energy consumption. This study uses data covering 44 years (1974 - 2018). The Nonlinear Autoregressive Distributed Lag (NARDL) method was used in this study. The results show in the short term, an increase in total international tourist arrivals has positive effect on increasing real GDP per capita and total energy consumption, while a decrease has positive effect on reducing real GDP per capita, CO2 emissions and total energy consumption. In the long term, an increase in total international tourist arrivals is known to have a positive effect on increasing real GDP per capita, CO2 emissions and total energy consumption, then the decrease has a positive effect on reducing real GDP per capita and CO2 emissions. This study fills the literature gap related to the effect of the number of international tourists the asymmetric relationship which is still rarely done in studies with similar topics in Indonesia.

Keywords: Emission; Energy Consumption; GDP; Tourism; NARDL
JEL Classification: C22, Q56, Z32

Introduction

Tourism is one of the most critical sectors of the Indonesian economy (Sujai, 2016). Over the last few years, tourism has made a substantial contribution to the Gross Domestic Product (GDP). The tourism sector is also one of the mainstays of the economy, and it plays a vital role in accomplishing sustainable development goals. (Davidson & Sahli, 2015; Kapera, 2018; T. H. Lee & Jan, 2019). This is because sectors that produce from non-renewable natural resources such as oil and gas cannot be relied on in the long term. Furthermore, despite growing social disparities and environmental costs, the tourism sector is driver of wealth and job creation. The United Nations (UN) declared 2017 as the International Year of Sustainable Tourism for Development, making it an opportunity to examine tourism's effect and support legislation that will make tourism a significant contributor to the Sustainable Development Goals (SDGs) (Nepal et al., 2019).

Figure 1 Contribution of the Tourism Sector to Indonesia's GDP



Sources: Ministry of Tourism and Creative Economy (2020)

In Indonesia, tourism is designated as one of the leading sectors. This is done with the aim of making the tourism sector a mainstay in obtaining foreign exchange which is expected to increase economic growth. It is known that the tourism sector can generate large amounts of foreign exchange and increases significantly every year, where the part of foreign exchange in this sector is known to be Rp. 175.71 trillion in 2015 to Rp. 229.50 trillion in 2018. The tourism sector also contributes to absorbing the labor force, which is shown by the total workforce in this sector which is increasing yearly. In 2015 there were 10.36 million workers, which then expanded in 2018 to 12.70 million people. The tourism sector also contributes significantly to GDP. It can be seen based on Figure 1 the average contribution of the tourism sector to GDP from 2015 to 2019 was 4.3 percent, of which the highest contribution occurred in 2019. This was driven by the increasing number of local and foreign tourists and investment Ministry of Tourism and Creative Economy (2020). Likewise, the number of foreign tourist visits to Indonesia has increased over the last five years. Based on Figure 2, it can be seen that the number of foreign tourist visits in 2019 reached 16.11 million and showed the highest number compared to previous years.

Figure 2 The Number of International Tourist Visits to Indonesia

Sources: Ministry of Tourism and Creative Economy (2020)

Over the previous two decades, the relationship between tourism and economic growth has been studied by Pigliaru & Lanza (2000). It is known that the causal relationship between tourism and growth includes four scenarios: tourism-led growth, economy-drive tourism, bidirectional causality and no-causality (Antonakakis et al., 2016). Several studies explain the truth of the Tourism-Led Economic Growth (TLEG) hypothesis, Tang & Tan (2018) for example, assess whether the TLEG hypothesis is internationally valid by taking into account the degree of state wealth and institutional quality using panel data from 167 nations. Their findings suggest that tourism helps to economic growth, although the effect differs depending on income levels and institutional quality. Antonakakis et al. (2015) using the spillover index technique to investigate the dynamic relationship between tourism growth and economic growth, found a relationship between tourists and economic growth but is not constant over time. Then, the results of his research also show that the TLEG and Economic-Driven Tourism Growth (EDTG) hypotheses are correct.

However, along with its positive effect on economic growth, the development of the tourism sector is also one of the contributors to increasing greenhouse gas (GHG) emissions significantly (Gössling, 2013; Gössling & Buckley, 2016). The success of the development in the tourism sector can be seen from the increase in the reception and number of tourists, which is based on research by Kuo et al. (2012), show that an increase in tourism revenue will only increase CO2 emissions and lower than the increase in the total of tourist visits in China. Solarin (2014), in his research on the presence or absence of long-term causality between tourist arrivals and pollution in multivariate analysis covering Gross Domestic Product (GDP), total energy consumption, financial development, and urbanization in Malaysia. His research also shows that an increase in the number of tourist arrivals has a positive impact on encouraging an increase in pollution. In Indonesia, Lee dan Syah (2018) examined the economic and environmental consequences of mass tourism on regional tourism destinations, particularly the establishment of the "Ten New Balis" in Indonesia from 1980 to 2015. Based on this research, it was found that there is a balance relationship long-term relationship between tourism receipts, environmental degradation, and economic growth.

By 2035, this sector is expected to account for around 7.5% of global CO2 emissions (UNWTO & WTO, 2008). One aspect of tourism that will contribute to emissions is foreign tourists, based on research by which became a catalyst for increasing CO2 emissions in Cyprus. In addition, Katircioglu (2014a) in another study, found similar evidence for Turkey, where international tourists also contributed significantly to increasing greenhouse gas emissions. However, some studies have found that tourist arrivals have a significant negative effect on CO2 emission levels in both the short and long term in Singapore (Katircioğlu, 2014b).

The majority of the extant literature discusses the impact of tourism on CO2 emissions through various channels of energy consumption (Koçak et al., 2020), where the aspect of tourism that has the greatest effect on energy use in international travel (Gössling et al., 2015). Tourism uses fossil energy sources predominantly, such as coal, natural gas, and oil, especially for transportation activities, activities in tourist destinations, and accommodation (Gössling & Peeters, 2015). Understanding how much energy consumption in tourist destinations can encourage the conservation of greenhouse gas energy through the formulation of policies and guidelines (Zhang & Zhang, 2019).

There are several previous studies that discuss the relationship between CO2 emissions, energy consumption and tourism. Among them are, Zaman et al. (2016) who used the Environmental Kuznets Curve (EKC) hypothesis to examine the relationship between carbon dioxide emissions and economic growth and tourism development as explained by tourism expenditure, receipts, and number of tourists in East Asia and Pacific countries, the European Union, and other high-income OECD and non-OECD countries from 2005 to 2013. The study's findings confirm that there is an inverse U-shaped link between carbon emissions and per capita income in the region, and that tourist expansion causes higher emissions. Wu et al. (2015) assess energy consumption and carbon dioxide emissions in China's tourist sector and compare overall emissions across key regions in their study.

The relationship between energy consumption, sustainable tourism, and destination management is complicated. As a result, a successful tourism destination cannot exist in the absence of long-term tourism growth. Tourism energy consumption is the key to achieving tourism and destination sustainability (Ritchie & Crouch, 2003). Further research on energy consumption should be encouraged, since understanding tourist energy consumption is becoming an essential approach for destinations to avoid environmental deterioration and foster ecologically responsible tourism growth (Zhang & Zhang, 2019).

Therefore, this research focuses on assessing the effect of the the number of tourist arrivals on CO2 emissions, total energy consumption, and economic growth as proxied by GDP per capita. This study tries to analyze how positive and negative changes in the tourism sector will affect economic growth, total energy consumption, and CO2 emissions or consider the existing asymmetric effects. The results of this study are expected to be a reference and recommendation in identifying strategies for the development of the tourism sector that seeks to balance economic growth while reducing pollutant emissions and encouraging energy efficiency.

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Research Method

Data

The data used include real GDP per capita and foreign tourist arrivals (total from the Central Statistics Agency (BPS) as well as data on total carbon dioxide emissions and total energy consumption from the World Bank. The data used is time series with a range from 1974 - 2018, which means there are 44 observations in this study.

Method

The Nonlinear Autoregressive Distributed Lag (NARDL) method was used in this study because it has several advantages. First, this method provides long-term and short-term estimates in one step. Second, this method can overcome the problem of bias in small samples and endogeneity bias which depends on the presence or absence of autocorrelation residuals. In addition, this method allows hidden Cointegration tests and includes an asymmetric dynamic multiplier that monitors the asymmetric intertemporal response of the dependent variable as a result of positive-negative changes in the independent variables (Nusair, 2016).

Model Specification

First, determine the symmetric linear equation model as follows:

$$lnY_t = \alpha + \theta T + \vartheta lntourist_t + \beta D + \mu_t$$

Where Y_t is the expected outcome consisting of real GDP value, carbon emissions and total energy consumption, $tourist_t$ is the number of tourists who come, T shows the trend, D is the dummy variable that shows structural breaks, α is the constant value, θT is coefficient of the time trend, μ_t is the assumption of the error term. This study uses an asymmetric long-run model based on partial sum decomposition based on Shin et al. (2014), as follows:

$$lnY_t = \alpha + \theta T + \vartheta^+ tourist_t^+ + \vartheta^- tourist_t^- + \delta D + \varepsilon_t$$

Where $\vartheta^+ = \vartheta^-$ indicates a symmetrical effect of tourist arrival on outcomes. If $\vartheta^+ > 0$ and $\vartheta^- > 0$ implies that increasing tourism will improve outcomes, vice versa. Shin et al. (2014) modified the symmetric Autoregressive Distributed Lag (ARDL) model developed by Pesaran et al. (2001) to analyze the problem of nonlinear and asymmetric effects using partial number decomposition determined in the following equation:

$$lntourist_t = lntourist_0 + lntourist_t^+ + lntourist_t^-$$

$lntourist_0$ is a variable value, $lntourist_t^+$ and $lntourist_t^-$ explain the process of partial addition that accumulates positive and negative changes in the tourist arrivals variable which is then described again in the following equation:

$$lntourist_t^+ = \sum_{j=1}^{t} \Delta lntourist_j^+ = \sum_{j=1}^{t} \max(\Delta lntourist_j, 0)$$

$$lntourist_t^- = \sum_{j=1}^{t} \Delta lntourist_j^- = \sum_{j=1}^{t} \max(\Delta lntourist_j, 0)$$

The two equations are an asymmetric cointegration model with partial sum decomposition. Then to estimate the asymmetric long-run and short-run elasticity, the specification model used is as follows:

$$\Delta lnYt = \theta_0 T + \theta_1 lnY_{t-1} + \theta_2^+ lntourist_{t-1}^+ + \theta_3^- lntourist_{t-1}^- + \sum_{j=1}^{q-1} \alpha_j \Delta lnY_{t-j} + \sum_{j=0}^{q-1} \beta_j^+ \Delta lntourist_{t-j}^+ + \sum_{j=0}^{q-1} \beta_j^- \Delta lntourist_{t-j}^- + \delta D + \mu_t$$

Then, to test the long-term asymmetry in the equation, a long-term null symmetry hypothesis test was carried out from $lntourist_t$ using the Wald Test where H_0: $\theta_2^+ = \theta_2^-$ and H_a: $\theta_2^+ \neq \theta_2^-$. In the same way, a short-term asymmetry test of $\Delta lntourist_t$ is also carried out, where H_0: $\sum_{j=0}^{q} \beta_j^+ = \sum_{j=0}^{q} \beta_j^-$ and H_a: $\sum_{j=0}^{q} \beta_j^+ \neq \sum_{j=0}^{q} \beta_j^-$. The null hypothesis of the symmetric effect test will be rejected if the $p - value \leq \alpha$, where α is the level of significance. Cointegration test is also performed on the equation, where H_0: $\theta_1 = \theta_2^+ = \theta_2^- = 0$ and H_a: $\theta_1 \neq 0$; $\theta_2^+ \neq 0$; $\theta_2^- \neq 0$. The null hypothesis indicates the condition when there is no cointegration and the alternative hypothesis is the opposite. The cointegration test criterion is if the *F-statistics* are above the upper critical bound $F - stat > I(1)_{critical}$), it can be said that there is cointegration or the null hypothesis is rejected. Meanwhile, if the *F-statistics* are below the lower critical bound ($F - stat < I(0)_{critical}$), it can be said that there is no cointegration or the null hypothesis cannot be rejected. Then if the F-statistics are between the upper and lower critical bounds, then the cointegration becomes uncertain. To estimate the asymmetric cumulative dynamic multiplier effects of lnY_t for each unit change of $lntourist_t^+$and $lntourist_t^-$, the following equation is used:

$$m_h^+ = \sum_{j=0}^{h} \frac{\partial lnY_{t+j}}{\partial lntourist_t^+};\ m_h^- = \sum_{j=0}^{h} \frac{\partial lnY_{t+j}}{\partial lntourist_t^-}, \qquad h = 0,1,2, \dots, \dots$$

Where according to Shahzad et al. (2017a) if the value of $h \to \infty$, then the value of m_h^+ and m_h^- will approach the long-term coefficient. By analyzing the adjustment pathway and the duration of the imbalance of certain positive and negative shocks, it will provide an overview of the short-term and long-term asymmetric adjustment patterns (Fousekis et al., 2016; Shahzad, et al., 2017b).

Result and Discussion

Summary Statistics dan Unit Root Test

Statistical information of the variables used can be seen in Table 1.

Table 1 Summary Statistics

Sum. Statistics	Real GDP	Tourist Arrival	CO^2 Emissions	Energy Consumption
Mean	925503.3	4350012	1.189858	98.64756
Maximum	5651456	1.58e+07	2.178462	158.83
Minimum	7269	313452	0.4022925	35.59
Std. Dev	1463498	3777920	0.516021	40.85881

The unit root test was performed using the Augmented Dickey-Fuller (ADF) test developed by Dickey dan Fuller (1979) and the Phillips-Perron test developed by Phillips dan Perron (1988). The unit root test can be seen in Table 2.

Table 2 Unit Root Test

	ADF Test		Pperron Test	
Variables	Level	First-Difference	Level	First-Difference
lny	-0.745	-7.008***	-0.691	-7.103***
lcoemis	-1.807	-5.347***	-1.812	-5.302***
lenergycons	-3.114***	-	-3.155***	-
lntourist	-1.232	-4.164***	-1.039	-4.236***

Note. ***p<0.01, **p<0.05, and *p<0.1

Based on the tests that have been carried out with a significance level of 5%, it can be seen that the GDP per capita and CO2 emissions variables are not stationary at the level but are stationary at the first-differences, both based on the ADF and Perron tests. While the total energy consumptions variable is stationary at the level.

Then the unit root test was also carried out on the structural breaks that had been made using the *xtbreak* test method by Ditzen et al. (2021) which can be used to estimate and test many known and unknown structural breaks in time series and panel data. The *vce(hac)* command is used to control autocorrelation and heteroscedasticity problems in the observed structural breaks. Structural break can be said to be significant if the value of *t-stat > bai-perron critical value* at a certain level, 1%, 5% or 10%. Based on the results, it is known that there are various results on the stationarity of the existing variables, where most of it is known that structural breaks tend to be more significant in the long term and only a few are significant in the short term. The unit root test on the structural break is shown in Table 3.

Table 3 Structural Breaks Unit Root Test

Variable	Level		First-Difference	
	NP-Stat	Break	NP-Stat	Break
Lny	22.08***	1983; 1993	0.50	1983; 1993
Lntourist	27.45***	1988	3.02	1984; 1993
lncoemiss	59.71***	1979; 2002	1.75	1980; 1989
Lntourist	3.14	1979; 1988	14.74***	1987; 1994
lnenergycons	18.06***	1996; 2002	13.38***	2002
Lntourist	13.81***	1986; 1992	17.66***	1986; 1992

Note. ***p<0.01, **p<0.05, and *p<0.1

Optimal Lag Length Test

An optimal lag length test was conducted for the nonlinear ARDL model on each dependent variable to be used. The lag length test is shown in table 4. Based on the results of the optimum lag test, it can be seen that all the variables that become the outcome have an optimum lag of 1.

Table 4 Lag Length Test

			Variabel: lny			
Lag	LL	LR	FPE	AIC	HQIC	SIC
0	61.1561	NA	0.000012	-2.83688	-2.79122	-2.7115
1	135.108	14.945*	5.0e-07*	-6.00526*	-5.82263*	-5.50372*
2	138.109	6.0027	6.7e-07	-5.71264	-5.39304	-4.83496
3	142.564	8.9095	8.5e-07	-5.49092	-5.03434	-4.23709
4	146.836	8.5447	1.1e-06	-5.2603	-4.66675	-3.63032
			Variabel: lncoemiss			
Lag	LL	LR	FPE	AIC	HQIC	SIC
0	207.775	NA	7.2e-09	-10.2387	-10.1929*	-10.1121*
1	217.897	20.244	6.8e-09*	-10.2948*	-10.1117	-9.78818
2	222.219	8.6439	8.7e-09	-10.0609	-9.74035	-9.17248
3	233.789	23.141*	7.8e-09	-10.1895	-9.73148	-8.9228
4	237.517	7.4556	1.1e-08	-9.92585	-9.33047	-8.27919
			Variabel: lnenergycons			
Lag	LL	LR	FPE	AIC	HQIC	SIC
0	123.046	NA	5.7e-07	-5.85589	-5.81023	-5.73051
1	237.854	29.622*	5.3e-09*	-11.0173*	-10.8346*	-10.5157*
2	239.836	3.9645	4.7e-09	-10.6749	-10.3553	-9.79726
3	245.435	11.197	5.6e-09	-10.509	-10.0524	-9.25519
4	249.874	8.8782	7.3e-09	-10.2865	-9.69299	-8.65656

Note. LL: log likelihood; LR: adjusted sequential LR test statistic; FPE: final prediction error; AIC: Akaike information criterion; SIC: Schwartz information criterion; HQIC: Hannan–Quinn information criteria.

Cointegration Test (Bounds Test)

Then, a bounds test is performed to determine whether the variables in the model have a cointegration or a long-term relationship. The results of the cointegration test (bounds test) are shown in Table 5. It can be seen that there is cointegration in the three models discussed in this study.

Table 5 NARDL Bounds Test

Model	Specification	F-Stat	α	PSS-Bounds	
				I(0)	I(I)
$lny_t \mid lntourism_t^+ \ lntourism_t^-; D$	NARDL(1,1)	F(2,42) = 5.95***	10%	2.788	3.540
			5%	3.368	4.203
			1%	4.800	5.725
$lncoemiss_t \mid lntourism_t^+ \ lntourism_t^-; D$	NARDL(1,1)	F(2,42) = 6.61***	10%	2.788	3.540
			5%	3.368	4.203
			1%	4.800	5.725
$lnenergycons_t \mid lntourism_t^+ \ lntourism_t^-;$	NARDL(1,1)	F(5,36) = 5.68***	10%	2.788	3.540
			5%	3.368	4.203
			1%	4.800	5.725

Note. ***$p<0.01$, **$p<0.05$, and *$p<0.1$

Then, Table 6 explains how the asymmetric effect of NARDL based on the three outcomes is trying to explain. Based on the estimation results, it can be seen that the asymmetric effect of international tourist arrivals on GDP per capita, CO2 emissions and total energy consumption is significant in both the short and long term.

Table 6 Asymmetric Effects Test

Null Hypothesis	Long-Run	Short-Run
Symmetric effect of tourism on Real GDP per capita	$\chi^2(I) = 7.37^{***}$ [0.000]	$\chi^2(I) = 3.71^{*}$ [0.060]
Symmetric effect of tourism on CO2 emissions	$\chi^2(I) = 10.27^{***}$ [0.000]	$\chi^2(I) = 6.51^{***}$ [0.003]
Symmetric effect of tourism on total energy consumption	$\chi^2(I) = 44.43^{***}$ [0.000]	$\chi^2(I) = 6.91^{***}$ [0.002]

Note. ***p<0.01, **p<0.05, and *p<0.1

NARDL Estimation

Regression was performed using NARDL to estimate the short-term and long-term asymmetric effects of international tourist visits on the dependent variables used, namely real GDP per capita, CO2 emissions and total energy consumption.

Table 7 Short-Run and Long-Run NARDL for Real GDP Per Capita

Outcome Variable(1): lny				
Variable	Coefficient	Standard Error	t-statistic	p-value
Short Run				
$\Delta lntourism_j^+$	3.38156***	1.402168	2.41	0.024
$\Delta lntourism_j^-$	0.73158***	1.501854	2.67	0.013
Long Run				
$lntourism_j^+$	3.31228***	0.493975	2.22	0.036
$lntourism_j^-$	1.2918*	0.870353	1.85	0.076
Deterministic				
Trend	-0.058030	0.043812	1.32	0.197
SB	-0.254651	0.296311	0.86	0.398
ECT	0.706023***	0.123435	5.72	0.000
Constanta	6.580389***	1.181342	5.57	0.000
R^2	0.8600			
$F_{FF}(17,25)$	9.03***			0.000

Note. ***p<0.01, **p<0.05, and *p<0.1

Table 7 shows the regression results for outcome variable 1, namely real GDP per capita. Based on the results, it is known that asymmetric international tourist visits (positive and negative) have a significant effect on real GDP per capita both in the short and long term. In the short term, an increase in the number of international tourist arrivals by 1 percent will increase real GDP by 3.38 percentage point, and a decrease in the number of international tourist arrivals will cause a decrease in real GDP by 0.73 percentage point, significant at the 1 percent significance level Meanwhile, in the long term, an increase in tourist arrivals also has a significant effect at a significance level of 1 percent, where a 1 percent increase in the number of international tourist arrivals will increase real GDP per capita by 3.28 percentage points and the decrease in tourist visits lowering the real GDP per capita by 1.29 percentage point, significant at the 10 percent significance level. Then, based on the table, it is known that the trend and structural break have no significant effect, while the error correction term has a significant effect of 74,52 percent at 1 percent significance level (obtained from 100×(exp(0.706023)-1). Where it shows a 74.52 percent correction of the imbalance that occurred in the current year and therefore a relatively rapid adjustment to the long-term equilibrium. The results in this study are in line with the research by Kumar et al. (2020) which examines the effect of international tourist arrivals on real GDP in Cook Island. Based on the results of the paper, it is known that an increase in international tourist arrivals has a significant effect on increasing real GDP both in the short and long term.

Table 8 Short-Run and Long-Run NARDL for CO2 Emissions

	Outcome Variable(2): lncoemiss			
Variable	Coefficient	Standard Error	t-statistic	p-value
Short Run				
$\Delta lntourism_j^+$	0.393980	0.367033	1.07	0.294
$\Delta lntourism_j^-$	0.27387***	0.316249	2.09	0.047
Long Run				
$lntourism_j^+$	0.983983***	0.420041	2.34	0.028
$lntourism_j^-$	0.52598*	0.299143	-1.76	0.091
Deterministic				
Trend	-0.042087***	0.043812	1.32	0.197
SB	-0.012334	0.296311	0.86	0.398
ECT	0.003807	0.123435	5.72	0.000
Constanta	0.136654***	1.181342	5.57	0.000
R^2	0.8600			
$F_{FF}(17,25)$	2.88***			0.008

Note. ***p<0.01, **p<0.05, and *p<0.1

Then the results for the dependent variable CO2 emissions are shown in Table 8. Based on the results, it can be seen that asymmetrically, international tourist visits have a significant effect on CO2 emissions in the long term, while in the short term, only the negative partial sums are significant. In the short term, a 1 percent decrease in the number of international tourist arrivals has an effect on reducing CO2 emissions by 0.27 percentage points. Meanwhile, in the long term, an increase in the number of tourist visits by 1 percent has an effect of 0.98 percentage points in increasing CO2 emissions, and a decrease of 1 percent has a smaller effect in reducing CO2 emissions, which is 0.56 percentage points. The coefficient of a significant trend at the 1 percent level is negative, which means it captures weakness in macroeconomic policies, lower investment and skilled worker emigration (Kumar & Stauvermann, 2016). The results of this study are in line with the research by Isola et al. (2018) which states that there is a positive long-term relationship between international tourist arrivals and CO2 emissions in Malaysia from 1972 – 2010.

Table 9 Short-Run and Long-Run NARDL for Total Energy Consumption

	Outcome Variable(3): lnenergycons			
Variable	Coefficient	Standard Error	t-statistic	p-value
Short Run				
$\Delta lntourism_j^+$	0.337568*	0.200690	1.74	0.094

$\Delta lntourism_j^-$	0.024918*	0.172057	1.85	0.076
Long Run				
$lntourism_j^+$	0.5147297***	0.219658	2.34	0.028
$lntourism_j^-$	-0.0244621	0.158727	-0.15	0.879
Deterministic				
Trend	-0.014554*	0.007925	-1.84	0.079
SB	-0.039115	0.036837	-1.06	0.299
ECT	-0.000163	0.015388	-0.01	0.992
Constanta	0.085736***	0.026213	3.27	0.000
R^2	0.7305			
$F_{FF}(17,25)$	3.83***			0.001

Note. ***p<0.01, **p<0.05, and *p<0.1

Then, based on Table 9, it can be seen that asymmetrically (both positive and negative) international tourist visits have a significant effect in the short term and in the long term only the increase has a significant effect. In the short term, it is known that an increase in international tourist arrivals by 1 percent has an effect on increasing total energy consumption by 0.33 percentage points, while a decrease of 1 percent only reduces total energy consumption by 0.02 percentage points. The results of this study are in line with research by Katircioglu (2014a) and Katircioğlu, (2014b) which state that in the long term, international tourist visits have a positive and significant effect on the amount of energy used. The results of this study are in line with the research by Khanal et al. (2021) which states that tourism contributes to encouraging greater energy consumption due to various activities in this sector, including transportation and hotel accommodation.

Causality and Stability Test

A causality test was conducted using the Vector Autoregressive (VAR) model to see how the relationship between the independent variable (x) and the dependent variable (y) was related. By setting the optimum lag of 1, linear and nonlinear causality tests were carried out.

Table 10 Symmetric Causality

Symmetric Causality		
Panel A: Causality Test (Dependent Variable: Real PDB Per Capita)		
x → y	lny_t	$lntourism_t$
lny_t	-	χ^2(I) = 3.9859**[0.046]
$lntourism_t$	χ^2(I) = 4.8541*[0.088]	-
Panel B: Causality Test (Dependent Variable: CO2 Emissions)		
x → y	$lncoemiss_t$	$lntourism_t$
$lncoemiss_t$	-	χ^2(I) = 9.7846***[0.002]
$lntourism_t$	χ^2(I) = 4.5376*[0.091]	-
Panel C: Causality Test (Dependent Variable: Total Energy Consumption)		
x → y	$lncoemiss_t$	$lntourism_t$
$lnenergycons_t$	-	χ^2(I) = 1.9385 [0.164]
$lntourism_t$	χ^2(I) = 6.7794 ***[0.004]	-

Note. ***p<0.01, **p<0.05, and *p<0.1

Symmetrical causality test shows that there is a two-way relationship between real GDP per capita and the number of international tourist arrivals as well as CO2 emissions and the number of international tourist visits. Then it is also known that there is a one-way relationship between international tourist visits and total energy consumption. The results of this study are in line with research by Kumar et al. (2020) which states that there is a two-way causality between the number of international tourist visits and the real value of GDP.

Table 11 Asymmetric Causality

Asymmetric Causality			
Panel A: Causality Test (Dependent Variable: Real PDB Per Capita)			
x → y	lny_t	$lntourism_t^+$	$lntourism_t^-$
lny_t	-	$\chi^2(I)$ = 4.5316**[0.033]	$\chi^2(I)$ = 4.8141*[0.090]
$lntourism_t^+$	$\chi^2(I)$ = 4.9089**[0.027]	-	$\chi^2(I)$ = 0.5254 [0.469]
$lntourism_t^-$	$\chi^2(I)$ =4.6991*[0.095]	$\chi^2(I)$ = 0.61849[0.432]	-
Panel B: Causality Test (Dependent Variable: CO2 Emissions)			
x → y	$lncoemiss_t$	$lntourism_t^+$	$lntourism_t^-$
$lncoemiss_t$	-	$\chi^2(I)$ = 17.475***[0.000]	$\chi^2(I)$ = 2.8871*[0.089]
$lntourism_t^+$	$\chi^2(I)$ = 6.1338**[0.013]	-	$\chi^2(I)$ = 1.0723[0.300]
$lntourism_t^-$	$\chi^2(I)$ = 6.6611**[0.036]	$\chi^2(I)$ = 0.41658[0.519]	-
Panel C: Causality Test (Dependent Variable: Total Energy Consumption)			
x → y	$lnenergycons_t$	$lntourism_t^+$	$lntourism_t^-$
$lnenergycons_t$	-	$\chi^2(I)$ = 2.5436 [0.111]	$\chi^2(I)$ = 1.384 [0.240]
$lntourism_t^+$	$\chi^2(I)$ = 7.4913 **[0.024]	-	$\chi^2(I)$ = 26503 [0.104]
$lntourism_t^-$	$\chi^2(I)$ = 3.1768* [0.075]	$\chi^2(I)$ = 1.3761 [0.241]	-

Note. ***p<0.01, **p<0.05, and *p<0.1.

Based on the asymmetric causality test that has been carried out, the results obtained are not much different from the symmetric causality test. Where it is known that there is a two-way relationship between an increase in international tourist arrivals ($lntourism_t^+$) and real GDP per capita, as well as a decrease in international tourist arrivals ($lntourism_t^-$) with real GDP per capita. Then there is also a two-way relationship between an increase in international tourist arrivals ($lntourism_t^+$) and CO2 emissions and a decrease in international tourist arrivals ($lntourism_t^-$) and CO2 emissions. Finally, there is a one-way relationship between the increase in international tourist arrivals ($lntourism_t^+$) to total energy consumption and a decrease in international tourist arrivals ($lntourism_t^-$) to total energy consumption.

Figure 3 VAR Model Stability Test for Dependent Variable Real GDP Per Capita

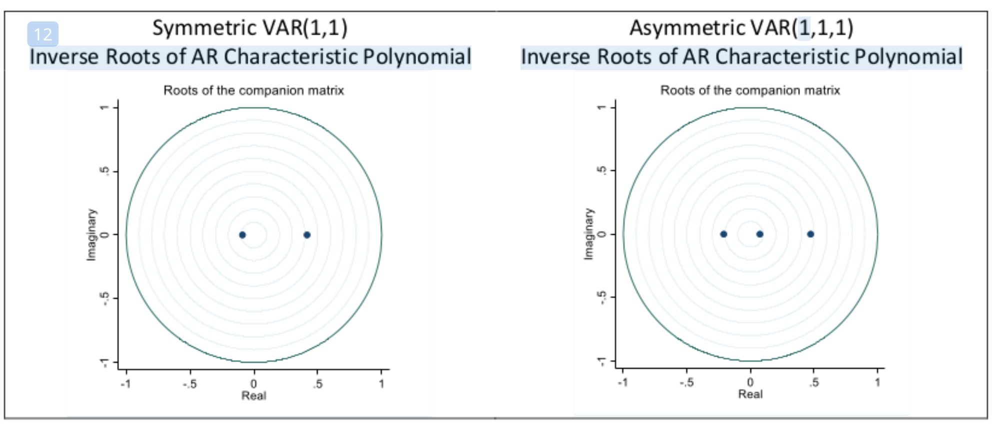


Figure 4 VAR Model Stability Test for Dependent Variable CO2 Emission

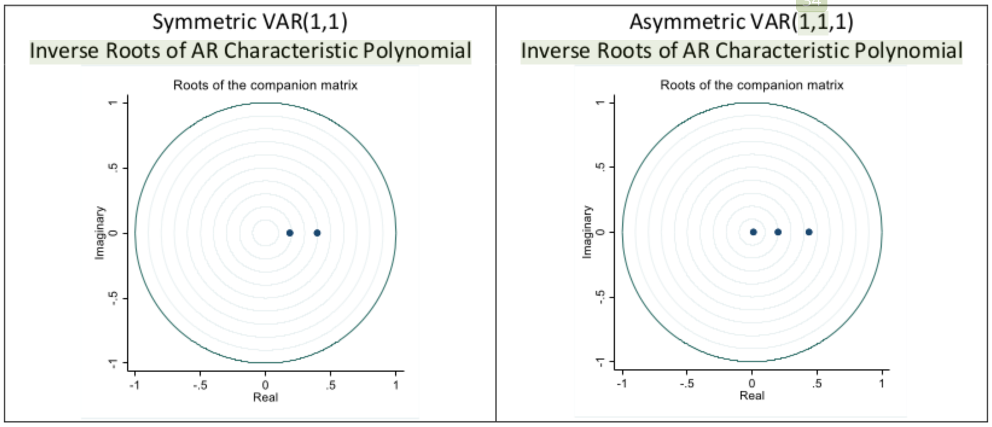
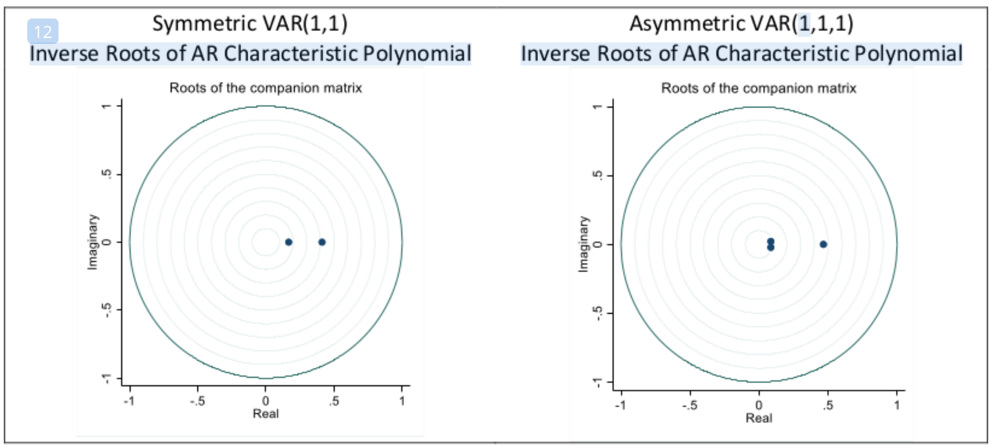


Figure 5 VAR Model Stability Test for Dependent Variable Total Energy Consumption



The stability of the VAR model was carried out using the inverse root of the autoregressive characteristic polynomial graph. Figures 3, 4 and 5 illustrate the stability of the VAR model for each dependent variable. Based on the figure, it can be seen that all VAR models are stable.

Conclusion

This study aims to examine the impact of the tourism sector as proxied by the number of tourist visits that have an impact on the environment in terms of CO2 emission conditions, total energy consumption and economic growth. Based on the estimation results, it can be seen that in the short term, an increase in total international tourist arrivals has a positive effect on increasing real GDP per capita and total energy consumption, while a decrease has a positive effect on reducing real GDP per capita, CO2 emissions and total energy consumption. In the long term, an increase in total international tourist arrivals is known to have a positive effect on increasing real GDP per capita, CO2 emissions and total energy consumption, then the decrease has a positive effect on reducing real GDP per capita and CO_2 emissions. Where the increase in the number of international tourist visits has a greater effect on real GDP per capita compared to CO_2 emissions and total energy consumption in the short and long term.

Based on the results of this study, it can be seen the importance of environmentally sustainable tourism in Indonesia. This is because if it is not handled properly, then along with the increase in the number of international tourists which has an impact on increasing national income, there will also be an increase in CO_2 emissions and total energy consumption. While along with the increase in emissions, there will be a portion of the national income spent on environmental restoration. Therefore, sustainable tourism is very important to be developed optimally in Indonesia. Because sustainable tourism not only takes full account of the economic benefits, but also the current and future social and environmental impacts, addressing the needs of visitors, industry (tourism), the environment and host communities (UNWTO, 2013).

There are several policy implications as a consideration of the results of this study. Given that an increase in the number of international tourist arrivals has a significant effect on CO_2 emissions and total energy consumption, the use of carbon neutral transportation and hybrid energy as well as the use of cleaner energy is deemed important. Hotels and other similar facilities can be encouraged to generate electricity from renewable sources. Governments can provide tax breaks or low-cost financing opportunities to purchase and install green technology for businesses in the tourism sector.

This study fills the literature gap related to the influence of the number of international tourist visits on growth as well as the environmental impact seen from CO_2 emissions and total energy consumption. This study looks at the asymmetric relationship of international tourist visits, which is still rarely done in studies with similar topics in Indonesia. This research uses the years 1974 - 2018, where sustainable-tourism has not yet become a crucial discussion for the public and has not been widely implemented by policy makers.

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